REMARKS

I. Status of the claims

Claims 1 and 2-26 are pending. Claim 2 has been cancelled. New claims 21-26 have been added. Claims 1 and 14 have been amended to recite a preferred glass-transition temperature range. Support for these amendments may be found on page 3, line 13 of the specification, as well as throughout the specification. Other amendments have been made to claims 1, 3, 4, 9, 13-16, and 20 to place the claims in better conformance with U.S. practice. No new matter has been added through these amendments.

II. Rejection of claims 1-20 based on Saito

Claims 1-20 are rejected under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over European patent Publication 917964 to Saito et al. ("Saito"). The examiner states that Saito discloses thermal transfer elements comprising supports and thermally transferable protective layers comprising polycarbonates with glass transition temperatures greater than 75°C and molecular weights of 5000 to 100,000, citing page 3, lines 3-40; page 4, lines 1-11 and lines 34-59; page 6, lines 36-41; page 11, lines 35-44; page 13, lines 5-26; page 15, lines 30-46; page 8, lines 41-51; and Figure 5. The examiner contends that if Saito does not anticipate the instant claims, then it would at least be obvious to one skilled in the art to use polycarbonates with molecular weights of the lower end of the molecular weight range disclosed in the European patent publication. The applicants respectfully traverse this rejection.

The present application addresses the problem of finding a thermally transferable overlay material for a thermal transfer medium that has both good printability and good protective properties. As explained in the introduction of the present specification, particularly on page 2, it is difficult to reconcile these properties in a single material. In particular, materials with good printability tend to tear or rupture during printing, exhibiting a phenomenon known as "flashing."

The present invention is based on the discovery that a suitable balance of properties can be achieved by use of a coating layer satisfying the following three criteria:

a) appropriate polymer chemistry, namely polyester;

b) appropriate glass transition temperature (Tg), namely greater than 50°C; and

c) appropriate molecular weight, namely in the range of 6,000 to 10,000.

Only by using an overlay material satisfying all three of these requirements are the desirable properties obtained. An overlay satisfying only two or less of these requirements, e.g. having incorrect polymer chemistry or inappropriate molecular weight, will not result in appropriate overlay characteristics.

Saito, on the other hand, relates to protective layers for thermal transfer prints, comprising particular aromatic polycarbonate resins having a glass transition temperature (Tg) of at least 80° C. The polycarbonate resins have a viscosity average molecular weight in the range of 5,000 to 100,000, preferably 10,000 to 50,000 (page 6, lines 19-20). The main function of this protective layer is to improve light fastness of a printed image. While Saito discloses the possibility that the protective layer also including a polyester resin having a Tg of at least 80° C (page 3, lines 39-40), there is no disclosure of the molecular weight of the polyester. The only discussion of molecular weight in the document relates either to the polycarbonate resin (page 6, lines 19-20) or optional random copolymer of reactive ultraviolet absorber with acrylic monomer (page 7, line 18). Accordingly, Saito neither teaches nor describes a coating layer comprising, either as an essential or optional feature, a polyester resin having both glass transition temperature and molecular weight characteristics as specified in the presently claimed invention.

Moreover, it is not appropriate to equate the particular aromatic polycarbonate resins disclosed in Saito with a polyester resin of the presently claimed invention. It is quite clear from Saito that polyester and aromatic polycarbonate resins are different. Referring to page 6, lines 36-39 of Saito, Saito distinguishes between the aromatic polycarbonate resins used in that invention and a possibility of adding a further resin such as a polyester, amongst others.

The applicants enclose a declaration under 37 C.F.R. § 1.132 by Dr. Andrew Clifton, a technical expert in the field of industrial polymers, to support the above-discussed distinctions. In the declaration, Dr. Clifton concludes that polyester materials as claimed in the present application are chemically and structurally distinct from polycarbonate materials disclosed in Saito. Accordingly, the declaration supports the applicants' remarks that the claimed invention is novel and unobvious over Saito.

On page 11, lines 35-42, Saito also discloses one specific polyester material, polyester resin (PEs-1). The polyester resin is stated to have a glass transition temperature of 92° C. No molecular weight details are given. However, a calculation can be made of the expected molecular weight of the polyester from the chemical description included on page 11. In particular, the molecular weight of the polyester is limited to the ratio of the "monomer" unit used in the preparation, as the reaction I is in reversible equilibrium. Saito discloses equal proportions of diacid and diol, which in principle should lead to a very high molecular eight polyester product.

If it is assumed that because of a rounding error there might be 1% excess diacid, then this would lead to a polymer starting with an acid group, alternating diol and diacid groups, and finally terminating after (on average) 100 repeats with another diacid. In this way, all the reactants are used up the molecular weight is of the order of 270 x 100 = 27,000. The molecular weight could only be decreased by having a greater mismatch between the components; this is clearly not what is described in Saito.

There is therefore no disclosure in Saito of use of a polyester material having a molecular weight ranging from 6,000 to 10,000, as recited in the claims of the present application. Thus, the claimed invention is novel over Saito.

Further, the claimed invention is not, in any way rendered obvious by Saito. The only discussion of molecular weight in Saito relates either to the polycarbonate resin (page 6, lines 19-20) or optional random copolymer of reactive ultraviolet absorber with acrylic monomer (page 7, line 18). These disclosures relating to preferred molecular weights for polycarbonates and random copolymers give rise to no expectation as to appropriate molecular weights for other materials; there is not reason to suppose that a molecular weight range that is optimal for one polymer (e.g., polycarbonate) would be optimal for another different class of polymers such as polyesters, differing both structurally and chemically. Additionally, there is not disclosure or suggestion in Saito that the molecular weight of polyester is of significance and might affect the characteristics of a resulting protective overlay.

Therefore, the claimed invention is in no way suggested or derivable from Saito.

There is no teaching or suggestion in Saito relating to the use of a coating layer satisfying the three elements of the claim discussed above. In particular, there is no teaching or suggestion

of a polyester having a molecular weight ranging from 6000 to 10,000. The polycarbonate resins disclosed in Saito document preferably have a molecular weight in a range 10,000 to 50,000 (page 6, lines 19-20), with the exemplified polycarbonates generally having a molecular weight in excess of 20,000. The only polyester disclosed in Saito has an expected molecular weight of about 27,000, as explained above. Saito therefore provides no hint or motivation to a skilled artisan of how to select the particular molecular weight range of 6,000 to 10,000 that is recited in claimed invention. Therefore, the claimed invention is both novel and unobvious over the Saito. Accordingly, the applicants respectfully request that the examiner withdraw the rejections under 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a) based on Saito.

III. Rejection of claims 1-3, 5, 6, 8-10, 12, 14, 15, 17, and 18 based on Hashimoto

The examiner rejected claims 1-3, 5, 6, 8-10, 12, 14, 15, 17 and 18 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over U.S. Patent No. 4,783,375 to Hashimoto et al. ("Hashimoto"). The examiner states that Hashimoto discloses thermal transfer elements comprising supports and thermally transferable layers comprising polyester with glass transition temperatures greater than 40° C and molecular weights less than 10,000, citing column 2, lines 36-55; column 3, line 39 – column 4, line 7; column 9, lines 1-30; column 10, lines 35-68; and Example 1. The examiner contends that if Hashimoto does not anticipate the instant claims, then it would at least be obvious to one skilled in the art of use polyesters in Hashimoto with preferred molecular weights less than 10,000 and glass transition temperatures in the preferred range of about 50 to 80° C. The applicants respectfully traverse this rejection.

Hashimoto relates to heat-sensitive recording material including a heat-sensitive ink layer comprising colouring material and polyester, for producing a colored printed image. This thus differs from the present invention, which claims a thermally transferable overlay material for application by mass transfer onto a previously printed image. The colored layer of Hashimoto is not intended for, nor is it suited for, use as an overlay; the colouring material would adversely affect a previously printed image if the layer were printed thereon. The Hashimoto material thus differs from the present invention. Accordingly, the applicants respectfully request the examiner to withdraw the rejections under 35 U.S.C. § 102(b) and 35 U.S.C. § 103(a) based on Hashimoto.

IV. Rejection of claims 1-10, 12, 14, 15, 17, and 18 based on Shimomine

The examiner rejected claims 1-10, 12, 14, 15, 17, and 18 under 35 U.S.C. § 102(b) as anticipated by or, in the alternative, under 35 U.S.C. § 103(a) as obvious over U.S. Patent No. 5,434,598 to Shimomine et al. ("Shimomine"). The examiner states that Shimomine discloses heat transfer elements with supports and heat transferable polyester layers with molecular weights of 5000 to 20,000 and glass transition temperatures of 45 to 80° C, citing column 4, lines 25-68 and Example 5. The examiner contends that if Shimomine does not anticipate the instant claims, then it would at least be obvious to on skilled in the art to use polyesters with molecular weights at the lower end of the disclosed range as in Example 5 and glass transition temperature above 50°C within the range of 45-80°C disclosed in Shimomine. The applicants respectfully traverse this rejection.

Shimomine discloses a thermal transfer ink sheet including a foundation layer, a release layer, a polyester resin barrier layer and a coloured layer including polyester resin (column 2, lines 47-54). The polyester in the colored layer preferably has a Tg of 45 to 80° C and a molecular weight of 5,000 to 20,000 (column 4, lines 55-59). The polyester of the barrier layer is preferably similar to those of the colored layer (column 5, lines 34-36). The ink sheet is for use with an image receiver comprising a plastic film with an image-receiving coating of a polyester resin with a Tg of 40 to 60° C (column 2, lines 40-45). Use of low Tg polyester is said to enhance the fixing properties of the printed image, and to strengthen the image against abrasion (column 2, line 65 to column 3, line 2). The polyester barrier of the ink sheet becomes the top layer of the printed image and provides protection (column 5, lines 27-29).

In Example 5, a thermal transfer ink sheet has a polyester resin barrier layer, using a polyester with a Tg of 52° C and a molecular weight of 7,000. Printing was performed onto a receiver having a polyester resin layer with a Tg of 45° C and a molecular weight of 20,000 (Examples 1 to 4 and Comparative Example) . The printed image was tested for resistance against a rubber eraser, alcohol and for anti-blocking properties.

In Shimomine, the thermal transfer sheet and the receiver sheet use similar polyester coatings, for good compatibility and thus formation of a strong bond between the similar polyesters.

The present invention uses a polyester layer on the thermal transfer medium wherein the polyesters have a higher Tg (of at least 75° C). Unlike Shimomine, the present invention does not require the presence of a similar polyester on the receiver; the thermal transfer medium can be used with a wide range of receivers, particularly with those comprising a coating of vinyl chloride/vinyl acetate copolymer, e.g. on a polyvinyl chloride card.

It is well known in the art that to form a strong bond between two polymer layers, this is best achieved if the two polymers are the same or closely similar. Shimomine makes use of this principle, requiring similar polyesters on the thermal transfer sheet and the receiver sheet.

The present inventors have surprisingly and unexpectedly found that the particular polyesters used on the thermal transfer medium can give a good bond with other materials on a receiver, such as receivers with a coating of vinyl chloride/vinyl acetate copolymer. Preferred copolymer coatings have a Tg of about 65° C, which is outside the range disclosed by Shimomine as being suitable for receiving the transfer.

A further distinction over Shimomine relates to the thickness of the polyester coating layer. Shimomine, at column 5, lines 45-47, discloses that the barrier layer when dried is present in an amount of 0.2 to 0.8 g/m^2. For material with a density of 1, this equates to a coating thickness of 0.2 to 0.8 microns. Polyesters have a density of slightly greater than 1, so the Shimomine coating thickness is slightly less than 0.2 to 0.8 microns. In contrast, the present invention requires use of a substantially thicker coat in order to provide a barrier able, in use, to protect the printed dyes against plasticisers, etc. Preferred coating thickness of the present invention are recited in claim 9.

Shimomine does not disclose a thermal transfer medium having a polyester with high Tgs, such as those recited in claims 3 and 4. Furthermore, there would be no motivation for a skilled artisan to use such higher Tg polyesters than those disclosed in Shimomine to transfer an adhesive protective layer onto a surface, particularly a surface that did not include a chemically similar coating. Accordingly, Shimomine does not teach or suggest the claimed invention recited in claims 3 and 4.

Independent claim 13, directed to a thermal transfer medium in the form of an elongate strip with sets of panels of different coatings (colored or overlay), is also novel and nonobvious over Shimomine. In Shimomine, the overlay material is superimposed on a colored layer.

Shimomine also fails to teach or suggest the combination of the thermal transfer medium of claim 1 and receiver material having an image-receiving surface comprising vinyl chloride/vinyl acetate copolymer, a method of forming an overlay using such a combination and the resulting product with overlay. The combination claims are recited in claims 21-25.

V. Conclusion

The applicants believe the all rejections set forth in the official action have been addressed. The examiner is encouraged to contact the undersigned counsel in order to resolve any remaining issues.

Please charge any fees associated with the submission of this paper to Deposit Account Number 033975. The Commissioner for Patents is also authorized to credit any over payments to the above-referenced Deposit Account.

Respectfully submitted,
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